

Fig. 1

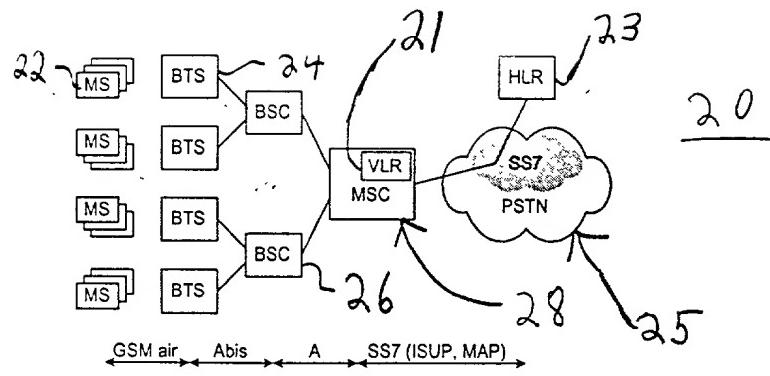


Fig.2

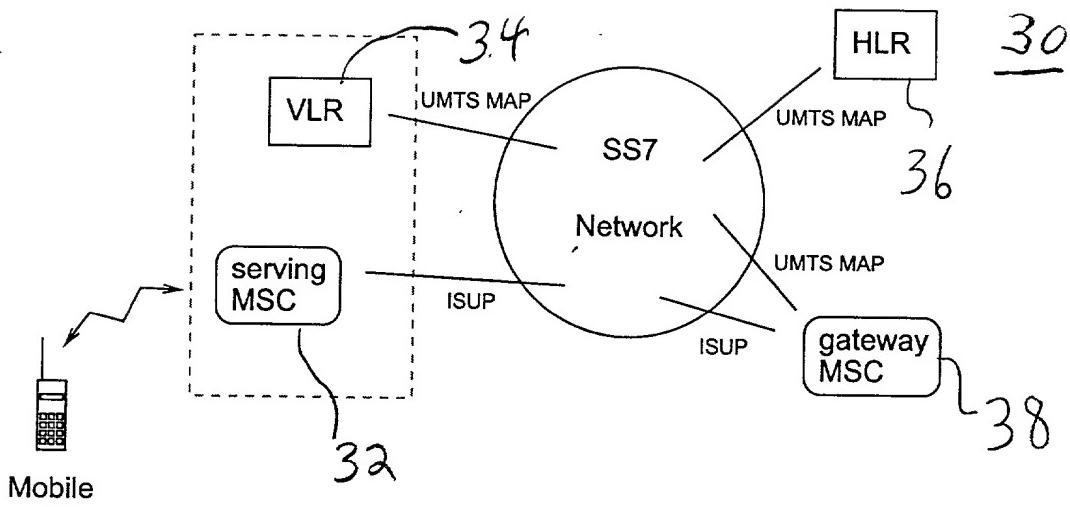


Fig. 3

400

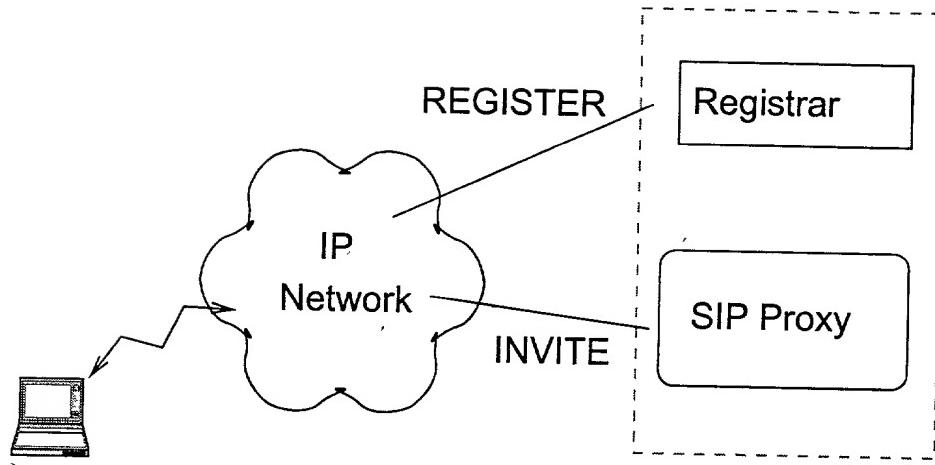


Fig.4

Analogous entities in SIP and UMTS	
UMTS	SIP
HLR	Registrar
Gateway MSC	Home proxy server
Serving MSC	End system (for REGISTER)
MSISDN	User address (in INVITE)
IMSI	User address (in REGISTER)
MSRN	Device address

Fig.5

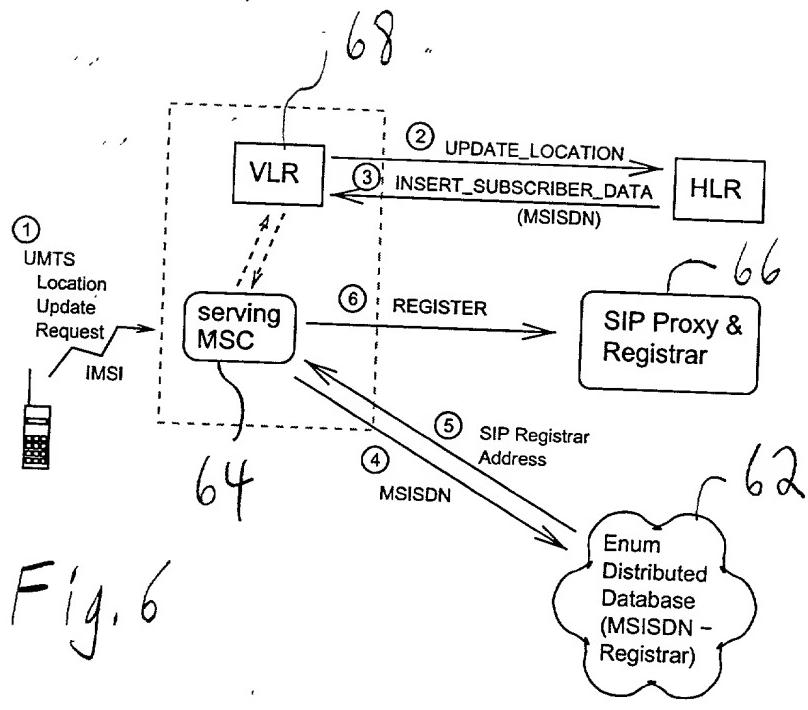
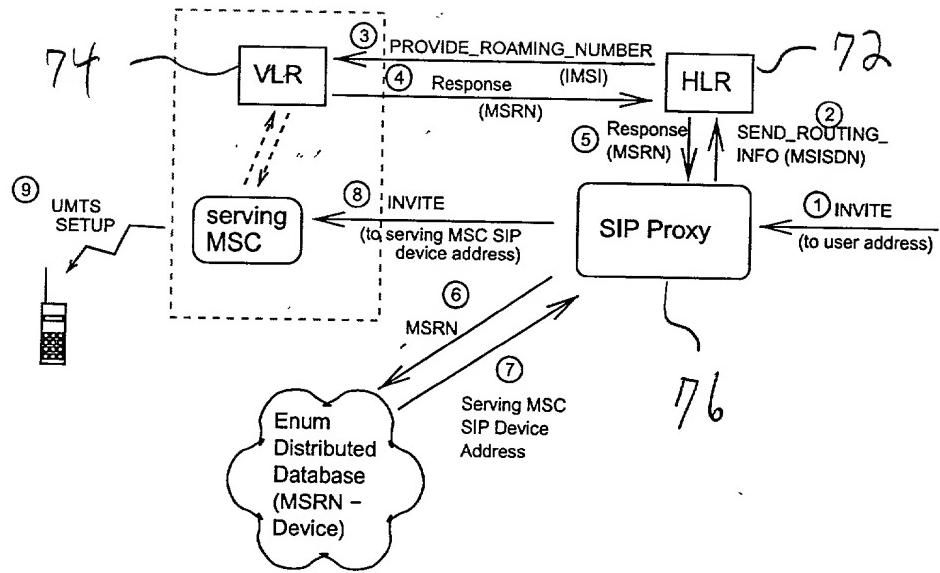


Fig. 7



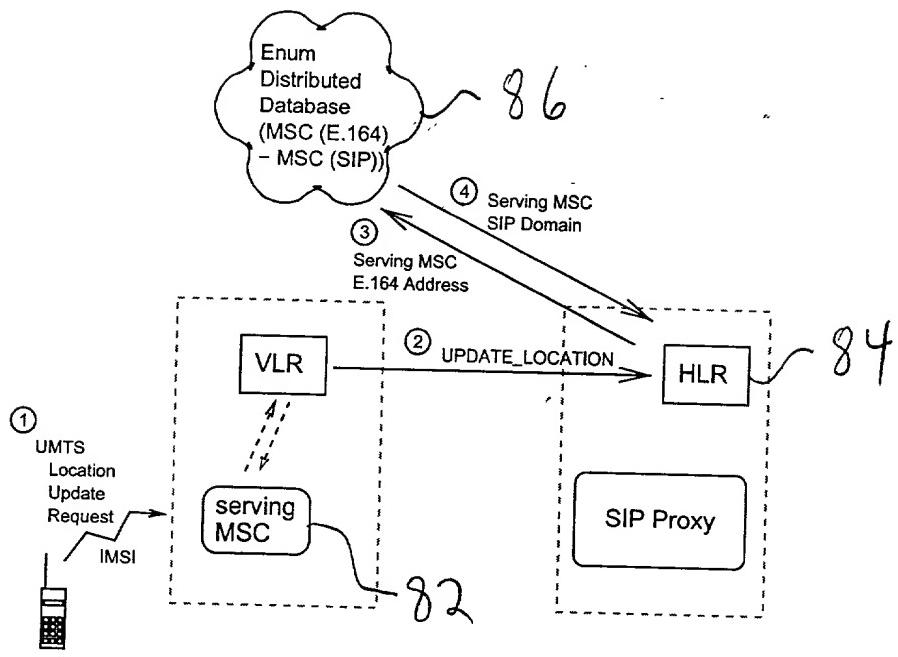


Fig. 8

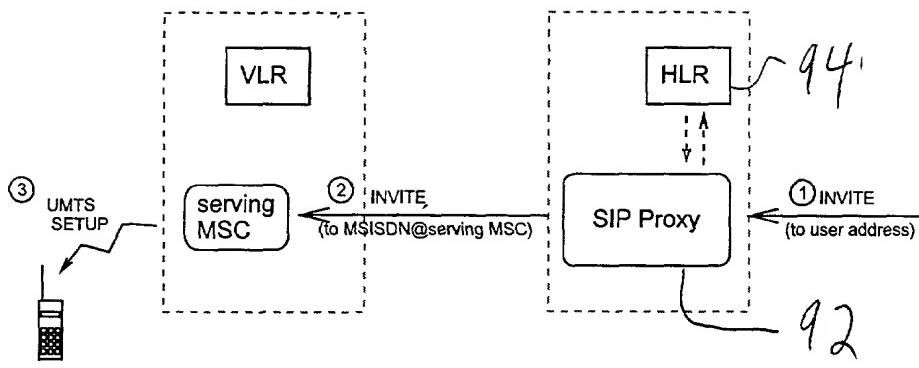


Fig. 9

Message weights

Symbol	Parameter	Value
w_{sip}	Weight of a SIP message	1.0
w_{isup}	Weight of an ISUP message	1.0
w_{dns}	Weight of a DNS message	0.5
w_{map}	Weight of a MAP message	1.5

Fig. 10

Mobility parameters		
Symbol	Parameter	Value
r_{in}, r_{out}	Rate of call delivery / origination	variable
r_{bc}	Average boundary crossing rate	variable
$P_t(t)$	Boundary crossing rate prob. distribution ($P(t_0 \geq t)$)	$e^{-r_{bc}t}$
s	Call / mobility ratio	$\frac{r_{out}+r_{in}}{r_{bc}}$
P_{nr}	Prob. that a device is new to a serving MSC	50%
P_{ur}	Prob. that a device has a unique registrar at its serving MSC	20%
P_{us}	Prob. that a device has a unique serving MSC at its HLR/registrar	20%

Fig.11

Protocol parameters		
Symbol	Parameter	Value
t_{sip}	SIP registration refresh interval	3 hr
t_{dns}	DNS cache time-to-live	24 hr
c_{auth}	Number of pieces of authentication data cached at VLR	5

Fig. 12

Case	Formula
Modified Registration	
Registration	$r_{bc}((8 + 2/c_{auth}) w_{map} + (2P_{nr} + 4P_{ur}) w_{dns} + 4(1 + \sum_{i=1}^{\infty} P_t(it_{sip})) w_{sip})$
Call setup	$r_{in}(4P_{us}w_{dns} + 1w_{sip})$
Modified Call Setup	
Registration	$r_{bc}(8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in}(4w_{map} + 6P_{us}w_{dns} + 1w_{sip})$
Modified HLR	
Registration	$r_{bc}((8 + 2/c_{auth}) w_{map} + 2P_{us}w_{dns})$
Call setup	$r_{in}(4P_{us}w_{dns} + 1w_{sip})$

Fig. 13

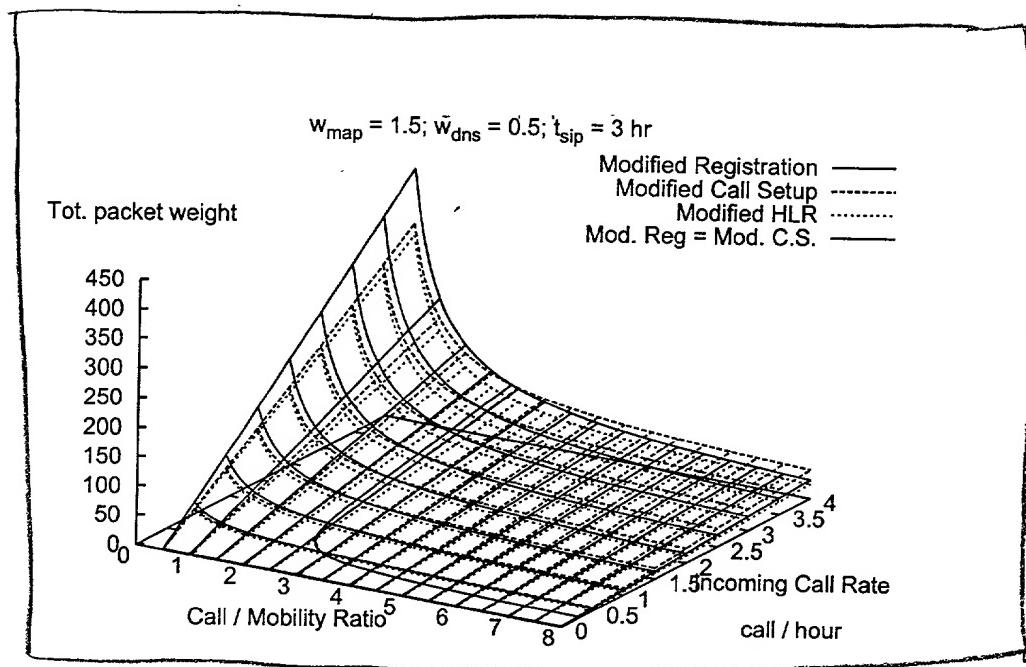


Fig. 14

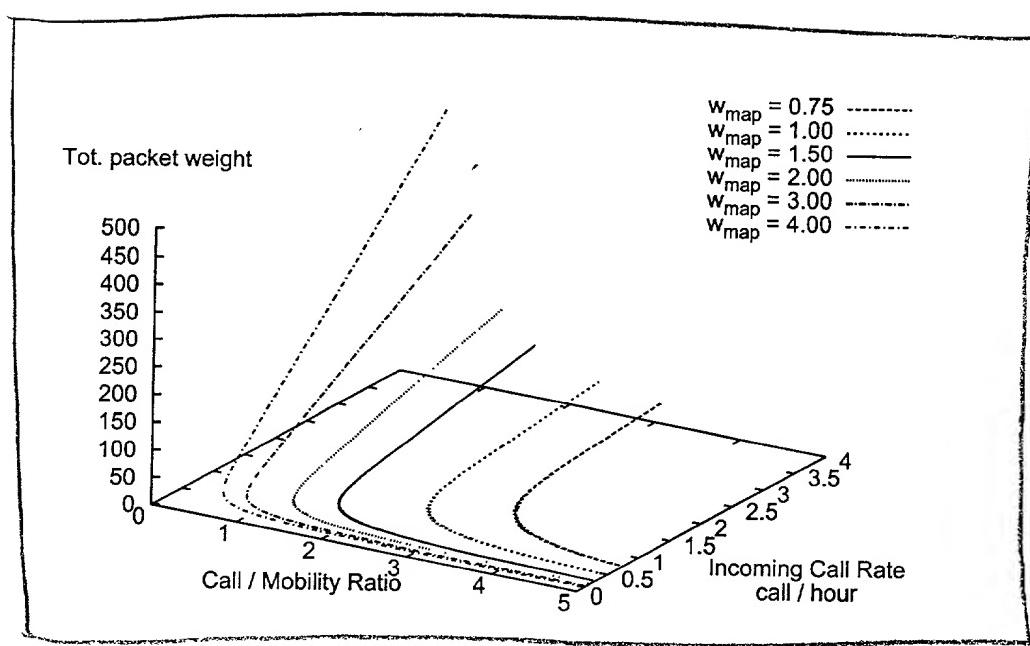
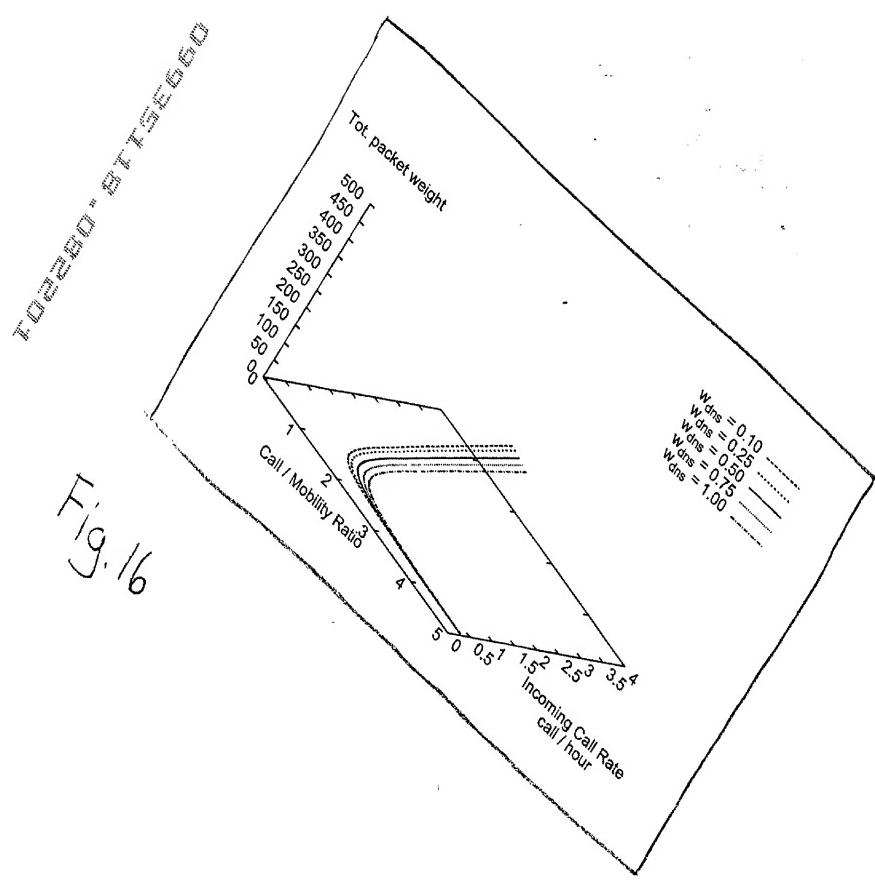


Fig. 15



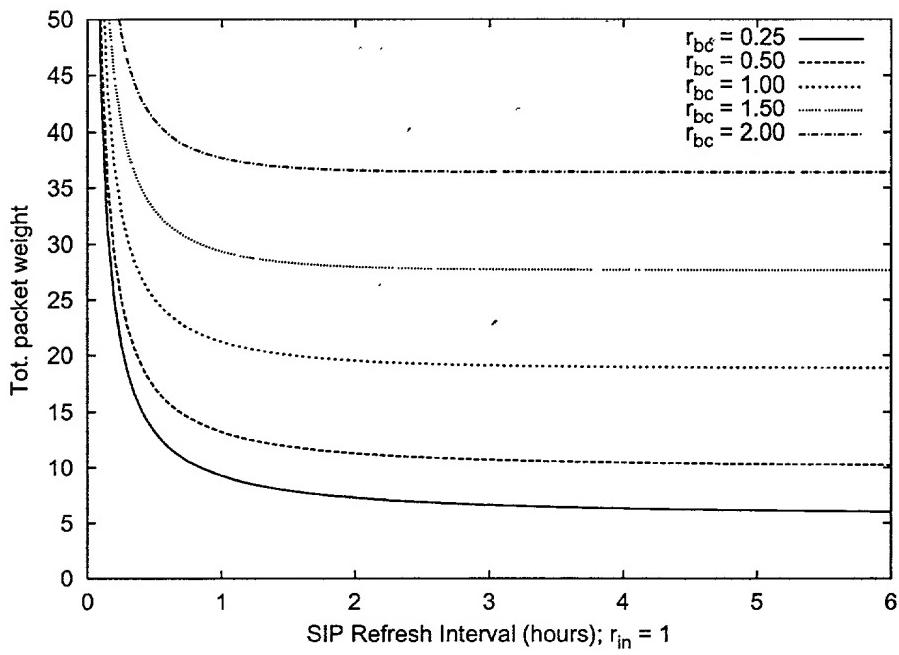


Fig. 17

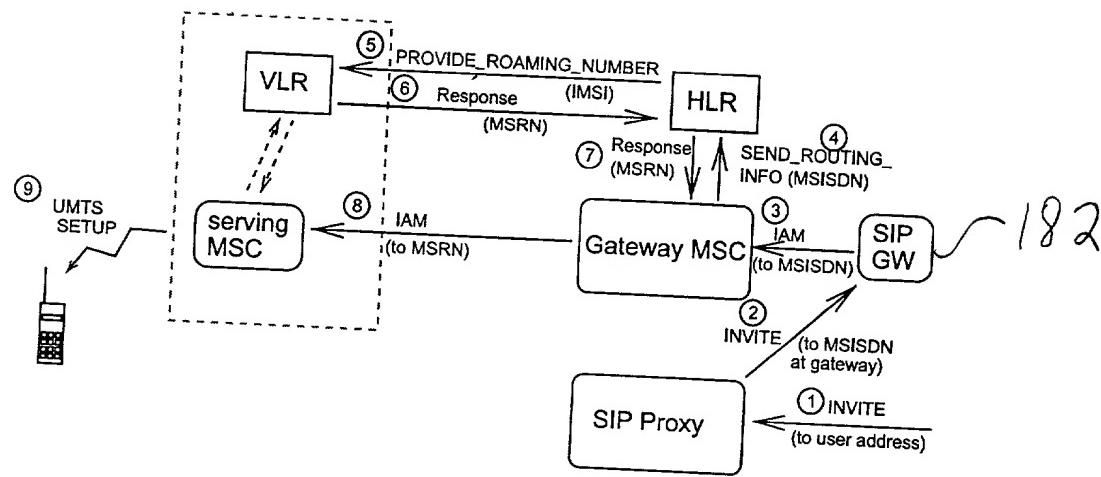


Fig. 18

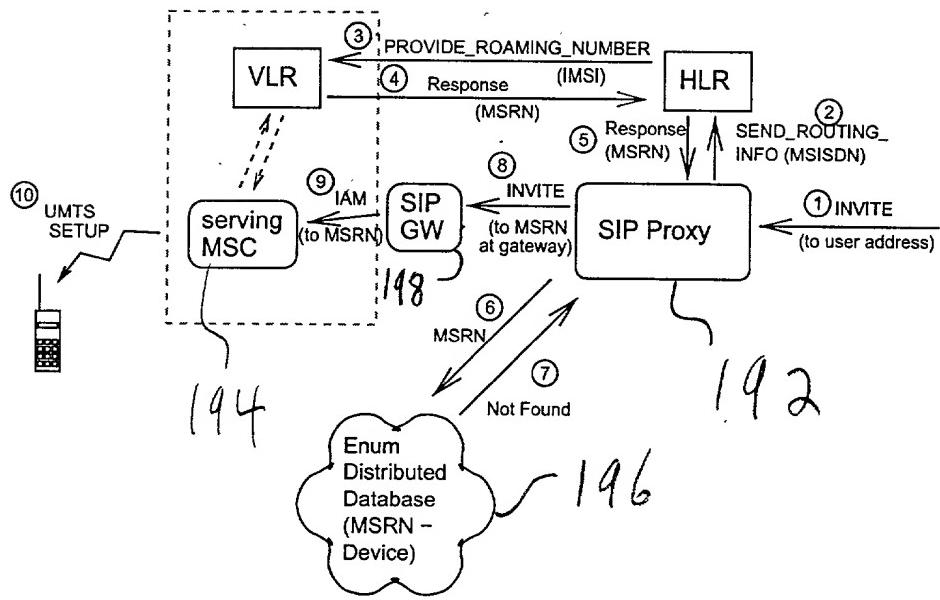


Fig.19

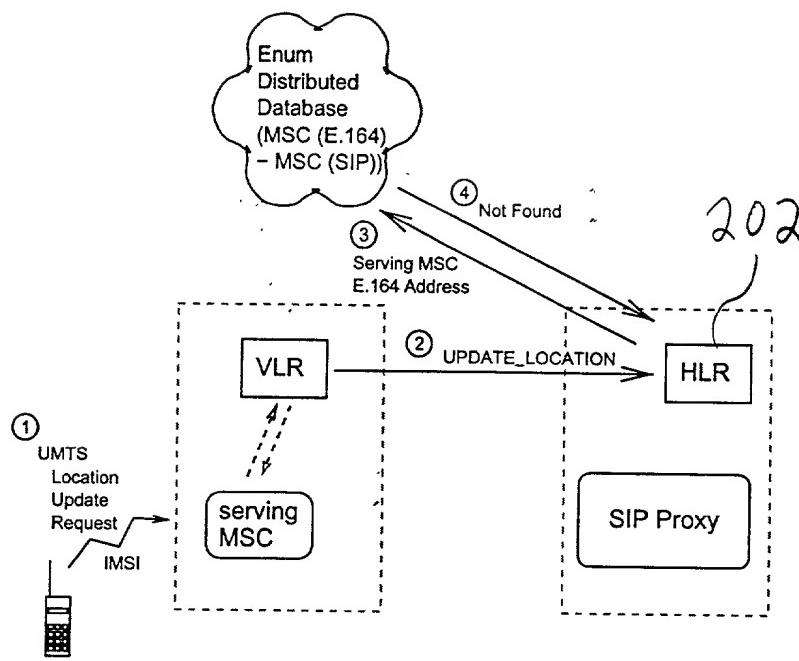


Fig.20

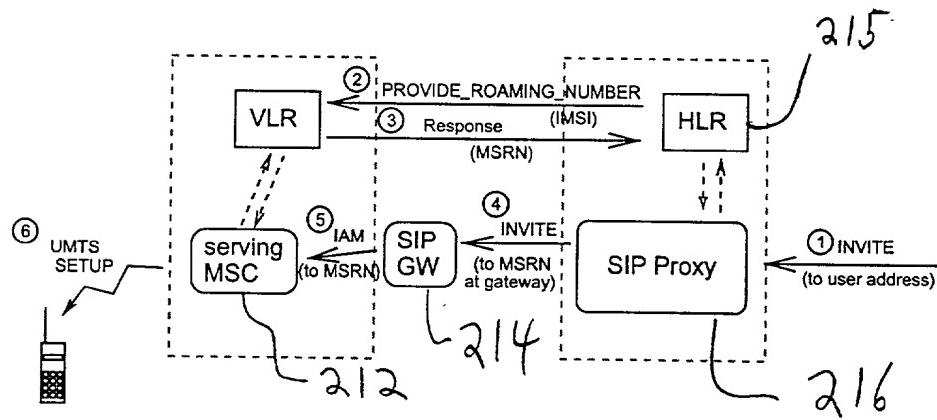


Fig.21

Case	Formula
Modified Registration	
Registration	$r_{bc} (8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in} (4w_{map} + 1w_{sip} + 2w_{isup})$
Modified Call Setup	
Registration	$r_{bc} (8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in} (4w_{map} + 6P_{us}w_{dns} + 1w_{sip} + 1w_{isup})$
Modified HLR	
Registration	$r_{bc} ((8 + 2/c_{auth}) w_{map} + 2P_{us}w_{dns})$
Call setup	$r_{in} (2w_{map} + 4P_{us}w_{dns} + 1w_{sip} + 1w_{isup})$

Fig.22

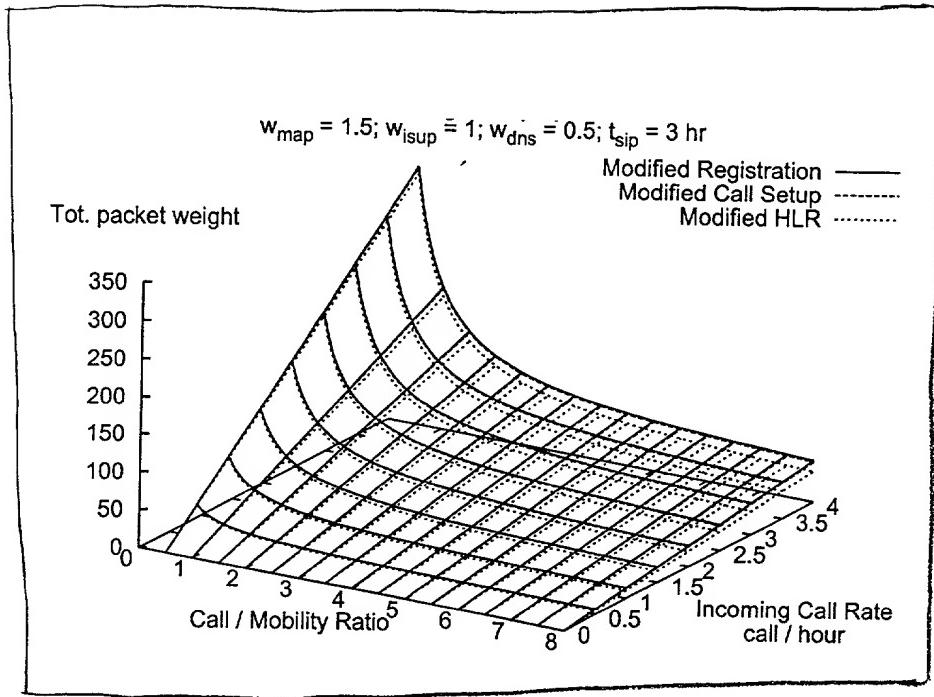


Fig. 23

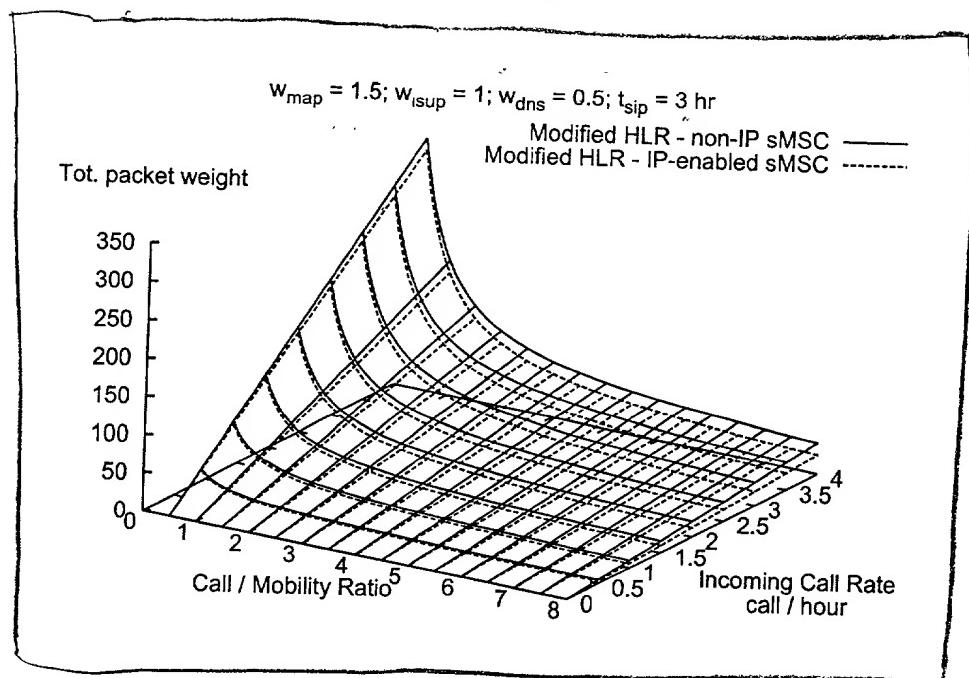


Fig.24

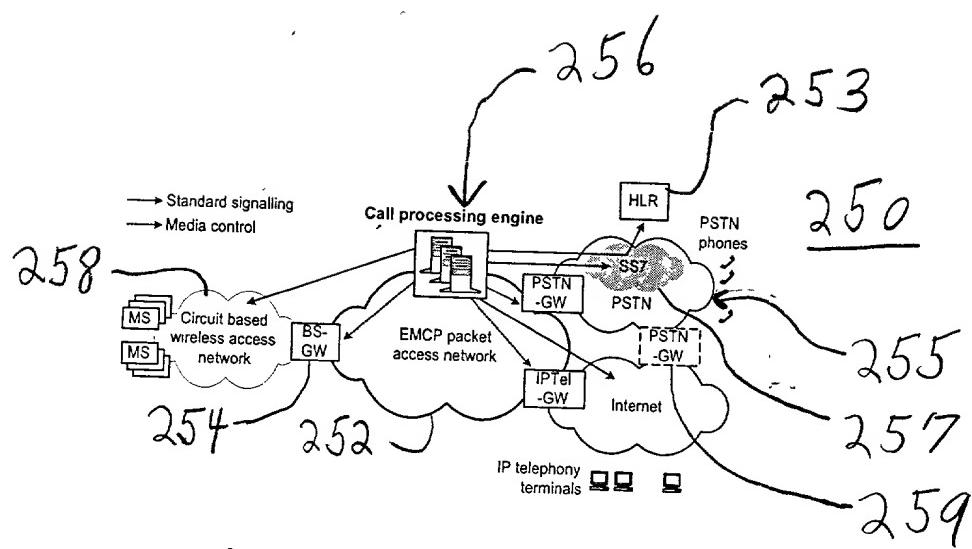


Fig. 25

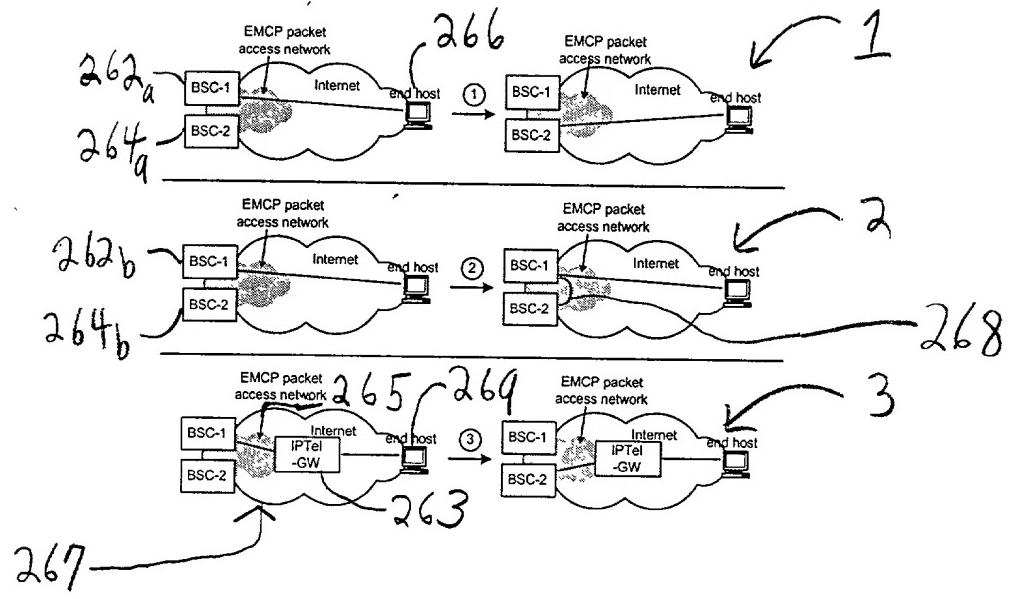


Fig.26

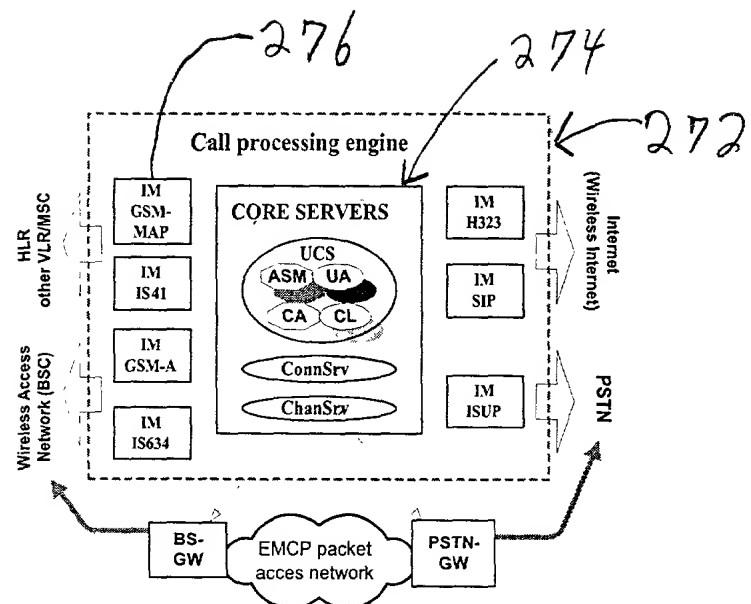


Fig.27

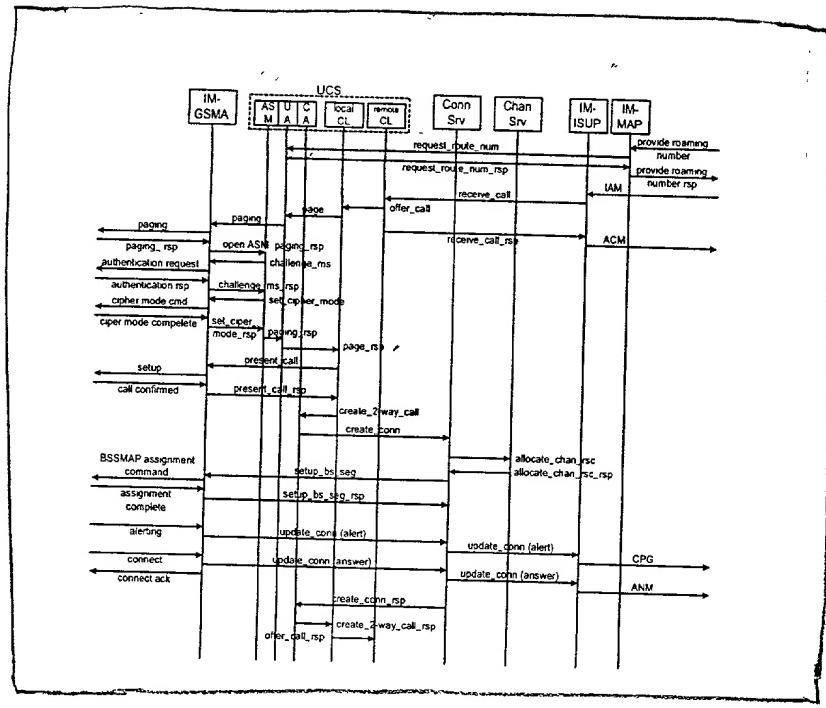


Fig. 28

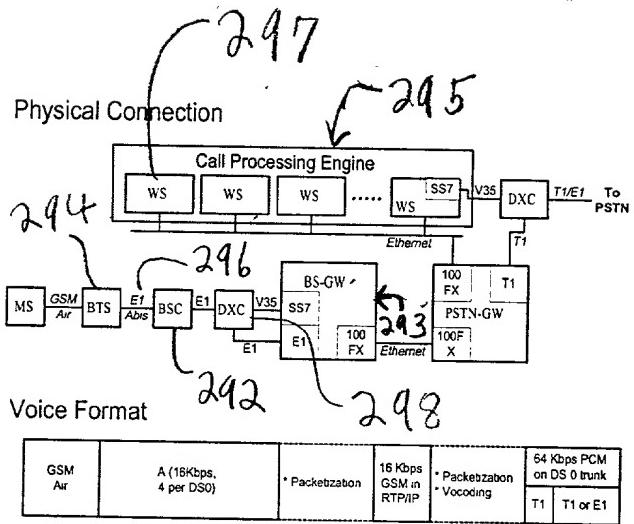


Fig. 29

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INDEPENDENT PARAMETERS.

	Description	Value
P	Number of processors (system size)	4
N	Average number of registered users	[80K,400K]
l_c	Call arrival rate (Poisson)	(0.3,5.5)
r_c	Ratio of MO calls within l_c	2/3
u	Call holding time (Exponential)	90 secs
l_r	Mobile registration rate (near-Poisson)	[0.1,2.0]
r_r	Inter-MSC registration ratio within l_r	1/7

Fig. 30

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DERIVED PARAMETERS.

	Description	Value
$l_c \cdot r_c$	MO call arrival rate (Poisson)	(0.2,3.65)
$l_c \cdot (1 - r_c)$	MT call arrival rate (Poisson)	(0.1,1.82)
$l_r \cdot r_r$	Boundary crossing rate	[0.014,0.29]
t	Call setup latency	measured

Fig.31

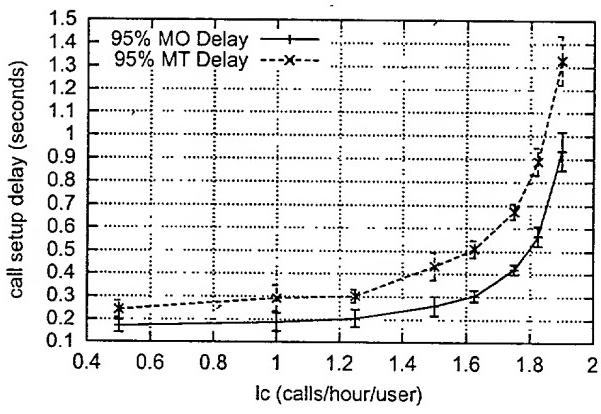


Fig. 32

332 a-d

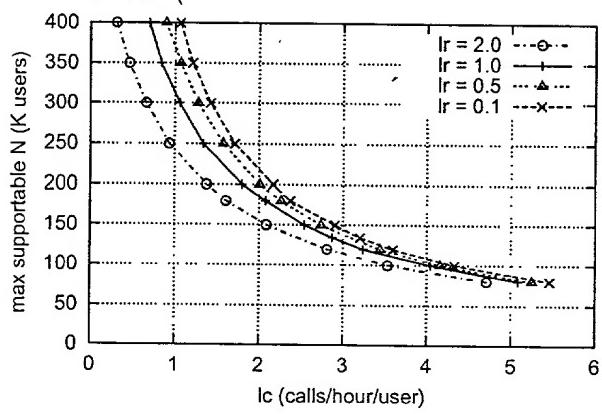


Fig. 33

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347
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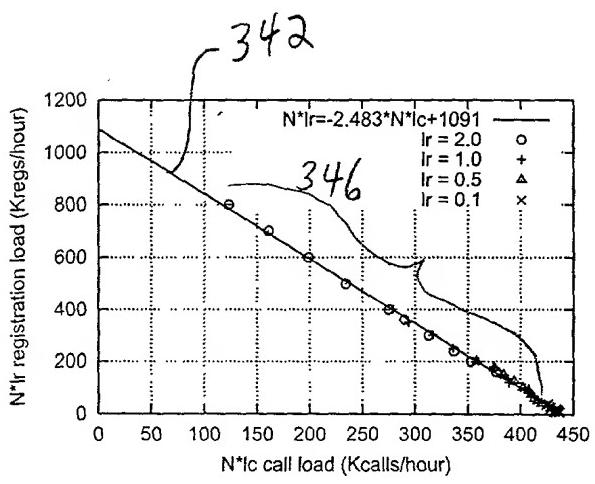


Fig. 34

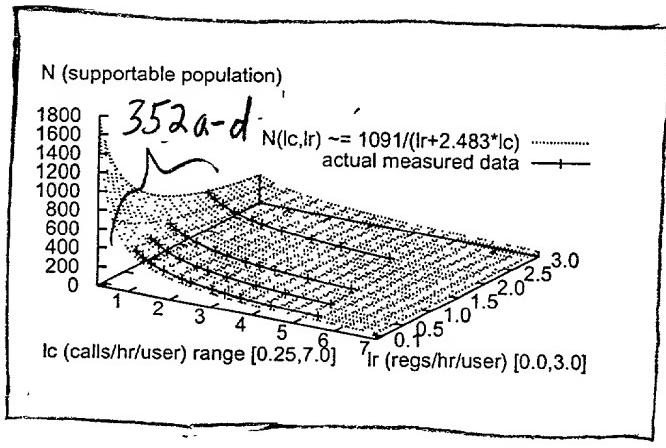


Fig. 35

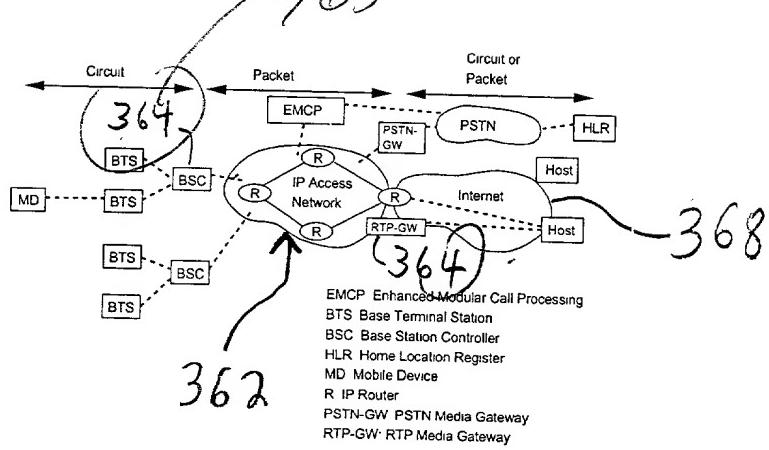


Fig. 36

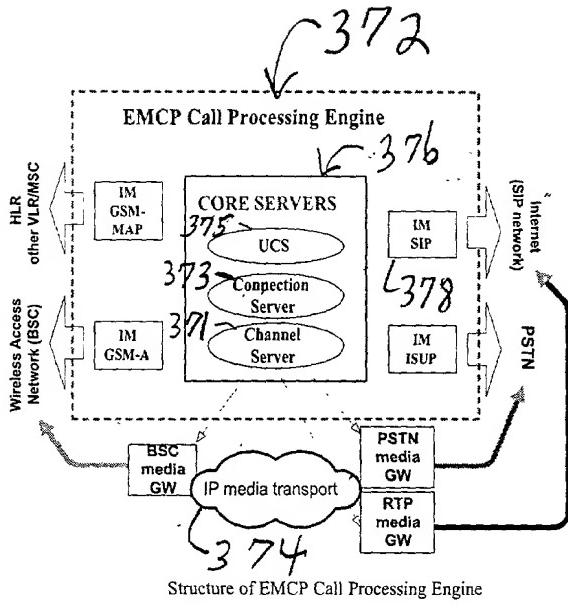


Fig. 37